

# CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: August 6, 2019

TO: Sheri Snowbank – Spooner Service Center

FROM: Wade Strickland – WY/3

*Diane Fisk for WS*

SUBJECT: Water Quality-Based Effluent Limitations for the Village of Osceola  
WPDES Permit No. WI-0025020-10-0

This is in response to your request for an evaluation of the need for water quality-based effluent limitations (WQBELs) using Chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable), for the discharge from the Village of Osceola in Polk County. This municipal wastewater treatment facility (WWTF) discharges to the St. Croix River, located in the Trout Brook Watershed in the Lower St. Croix River Basin. This discharge is included in the Lake St. Croix TMDL as approved by EPA. The evaluation of the permit recommendations is discussed in more detail in the attached report.

Based on our review, the following recommendations are made on a chemical-specific basis at Outfall 001:

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
BOD <sub>5</sub>			45 mg/L	30 mg/L	1
TSS			45 mg/L	30 mg/L	1
pH	9.0 s.u.	6.0 s.u.			1
Fecal Coliform April 15 – October 15			<b>656#/100 mL</b> geometric mean	400#/100 mL geometric mean	3
Ammonia Nitrogen November – April	Variable		<b>108 mg/L</b>	<b>108 mg/L</b>	2,3
Phosphorus TBEL WQBEL				1.0 mg/L 9.2 lbs/day	1
Hardness, Total as CaCO <sub>3</sub>					4
Copper, Total Recoverable					4
Chloride					4
WET Testing					5

## Footnotes:

1. No changes from the current permit.
2. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7) are included in bold.
3. The variable daily maximum ammonia nitrogen limit table corresponding to various effluent pH values may be included in the reissued permit in place of the single limit of 46 mg/L. These limits, in addition to the weekly and monthly average limits, are required seasonally during the months of November – April. Monitoring is recommended during the months of May – October during the third year of the reissued permit term to ensure that 11 sample results are available at the next permit issuance to meet the data requirements of s. NR 106.05(4).

### Daily Maximum Ammonia Nitrogen Limits – WWSF

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
6.0 < pH ≤ 6.1	108	7.0 < pH ≤ 7.1	66	8.0 < pH ≤ 8.1	14
6.1 < pH ≤ 6.2	106	7.1 < pH ≤ 7.2	59	8.1 < pH ≤ 8.2	11
6.2 < pH ≤ 6.3	104	7.2 < pH ≤ 7.3	52	8.2 < pH ≤ 8.3	9.4
6.3 < pH ≤ 6.4	101	7.3 < pH ≤ 7.4	46	8.3 < pH ≤ 8.4	7.8
6.4 < pH ≤ 6.5	98	7.4 < pH ≤ 7.5	40	8.4 < pH ≤ 8.5	6.4
6.5 < pH ≤ 6.6	94	7.5 < pH ≤ 7.6	34	8.5 < pH ≤ 8.6	5.3
6.6 < pH ≤ 6.7	89	7.6 < pH ≤ 7.7	29	8.6 < pH ≤ 8.7	4.4
6.7 < pH ≤ 6.8	84	7.7 < pH ≤ 7.8	24	8.7 < pH ≤ 8.8	3.7
6.8 < pH ≤ 6.9	78	7.8 < pH ≤ 7.9	20	8.8 < pH ≤ 8.9	3.1
6.9 < pH ≤ 7.0	72	7.9 < pH ≤ 8.0	17	8.9 < pH ≤ 9.0	2.6

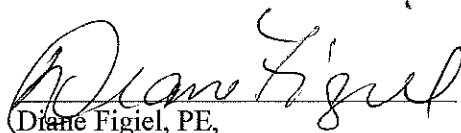
4. Monthly monitoring is recommended during the third year of the reissued permit term to ensure that 11 samples are available at the next permit issuance to meet the data requirements of sections NR 106.05(4) and NR 106.85 respectively. Hardness monitoring is recommended because of the relationship between hardness and the daily maximum copper limit.
5. Following the guidance provided in the Department's WET Program Guidance Document (revision #11, dated November 1, 2016), no WET testing is required.

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Michael Polkinghorn at (608) 266-3906 (Michael.Polkinghorn@wisconsin.gov) and Diane Figiel at (608) 264-6274 (Diane.Figiel@wisconsin.gov).

Attachments (3) – Narrative, Map, & Data Source Table

PREPARED BY: Michael A. Polkinghorn, E.I.T. – Water Resources Engineer

APPROVED BY:

 Date: 8/6/19  
Diane Figiel, PE,  
Water Resources Engineer

E-cc: Jordan Englebert, Wastewater Engineer – Spooner Service Center  
Michelle Balk, P.E., Northern Region Wastewater Supervisor – Spooner Service Center  
Diane Figiel, P.E., Water Resources Engineer – WY/3

Attachment #1  
**Water Quality-Based Effluent Limitations for  
the Village of Osceola**

**WPDES Permit No. WI-0025020-10-0**

Prepared by: Michael A. Polkinghorn, E.I.T.

**PART 1 – BACKGROUND INFORMATION**

**Facility Description:** The wastewater treatment facility (WWTF) is designed to treat 0.606 MGD of influent and treats on average 0.263 MGD (October 2014 – April 2019 data). Preliminary treatment consists of a fine bar screen and grit separators for debris solids removal. Influent is combined at the headworks with aerobic digester supernatant and combined wastewater of Village of Dresser and Ellsworth West Central Biosolids Facility supernatant. Primary and secondary treatment are achieved by an aerated oxidation ditch via activated sludge, where naturally occurring metabolizing microorganisms present in the wastewater break down organic matter. Ferric chloride is added at the influent of the oxidation ditch for chemical phosphorus removal. Tertiary treatment is utilized by two final clarifiers in parallel where suspended solids are settled out, and an ultraviolet light unit where bacteria are disinfected. Disinfection occurs seasonally from April 15 – October 15 and effluent is discharged year round to the east bank of the St. Croix River approximately 0.5 miles downstream (south) of the Highway 243 Bridge.

Sludge is removed from the final clarifiers where a portion is returned to the oxidation ditch to re-seed influent wastewater. The remainder is treated by the aerobic digester to reduce pathogens to safe levels. The sludge is hauled to the Ellsworth West Central Biosolids Facility for further treatment where resulting facility supernatant is hauled to a receiving tank in Dresser, WI. The combination wastewater of the Village of Dresser and supernatant are returned to the WWTF for treatment.

Attachment #2 is a map of the area showing the approximate location of Outfall 001.

**Existing Permit Limitations:** The current permit, expiring on 9/30/2019, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
BOD <sub>5</sub>			45 mg/L	30 mg/L	1
TSS			45 mg/L	30 mg/L	1
pH	9.0 s.u.	6.0 s.u.			1
Fecal Coliform April 15 – October 15				400#/100 mL geometric mean	1
Ammonia Nitrogen					2
Phosphorus TBEL WQBEL				1.0 mg/L 9.2 lbs/day	3
Hardness, Total as CaCO <sub>3</sub>					2
Copper, Total Recoverable					2
Chloride					2

Footnotes:

1. These limitations are not being evaluated as part of this review. Because the water quality criteria (WQC), reference effluent flow rates, and receiving water characteristics have not changed, limitations for these water quality characteristics do not need to be re-evaluated at this time.
2. Monitoring only
3. This is a technology-based effluent limit (TBEL) for phosphorus as described in s. NR 217.04(1). The final TMDL-based WQBEL is 9.2 lbs/day as a monthly average.

**Receiving Water Information:**

- Name: St. Croix River
- Classification: Warm Water Sport Fish Community, Exceptional Resource Water, non-public water supply.
- Low Flow: The following 7-Q<sub>10</sub> and 7-Q<sub>2</sub> values are from USGS for Station SW ¼, NW ¼, Sec. 30, T34N-R18W at St. Croix Falls, approximately 8.4 miles upstream of Outfall 001. The Harmonic Mean has been estimated as recommended in *State of Wisconsin Water Quality Rules Implementation Plan* (Publ. WT-511-98)  
7-Q<sub>10</sub> = 1,100 cfs (cubic feet per second)  
7-Q<sub>2</sub> = 1,530 cfs  
Harmonic Mean Flow = 3,200 cfs
- Hardness = 106 mg/L as CaCO<sub>3</sub>. This value represents the geometric mean of data of five historic WET tests from September 1996 – March 2010.
- % of low flow used to calculate limits: 25% as described in s. NR 106.06(4)(c)5.
- Source of background concentration data: Metals data from the St. Croix River @ Highway 8 near St. Croix Falls is used for this evaluation. The numerical values are shown in the tables below. If no data is available, the background concentration is assumed to be negligible and a value of zero is used in the computations. Background data for calculating effluent limitations for ammonia nitrogen are described later.
- Multiple dischargers: There are several other dischargers to the St. Croix River however they are not in the immediate vicinity and the mixing zones do not overlap. Therefore, the other dischargers do not impact this evaluation.
- Impaired water status: The St. Croix River is an impaired water due to fish tissue being contaminated with polychlorinated biphenols (PCBs). This does not impact the calculated WQBELs.

**Effluent Information:**

- Flow Rate(s):  
Annual average design = 0.606 MGD (Million Gallons per Day)  
For reference, the actual average flow from October 2014 – April 2019 was 0.263 MGD.
- Hardness = 216 mg/L as CaCO<sub>3</sub>. This value represents the geometric mean of permit monitoring data from January 2018 – October 2018.
- Acute dilution factor used: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).
- Water Source: Domestic wastewater from the Villages of Osceola and Dresser with no significant industrial contributors. Supernatant is taken from the Ellsworth West Central Biosolids Facility. Water sources include Osceola Waterworks and the Village of Dresser.
- Additives: Ferric chloride is utilized for chemical phosphorus removal. Polyphosphate is added to the water source by Osceola Waterworks.
- Effluent characterization: This facility is categorized as a minor municipality, so the permit

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application required effluent sample analyses for a limited number of common pollutants, primarily metal substances plus Ammonia, Chloride, Hardness and Phosphorus.

Sample Date	Copper $\mu\text{g/L}$	Chloride $\text{mg/L}$
01/31/2018	24	242
02/28/2018	17	
03/07/2018	15	
04/11/2018	10	239
05/09/2018	57*	
06/13/2018	13	
07/11/2018	12	
08/22/2018	10	247
09/12/2018	10	
10/10/2018	7	231
11/14/2018	7	
12/12/2018	13	
01/23/2019	10	
1-day $P_{99}$	27	
4-day $P_{99}$	19	
30-day $P_{99}$	14	
Mean	12	240
Std	5	6.70
Sample Size	12	4
Range	7 – 24	231 – 247

\*The copper sample of 57  $\mu\text{g/L}$  was determined to be an outlier using the Grubb's one-tailed test and was not used in the  $P_{99}$  calculations.

Effluent data for substances for which a single sample was analyzed is shown in the tables in Part 2 below, in the column titled "MEAN EFFL. CONC.".

The following table presents the average concentrations and loadings at Outfall 001 from October 2014 – April 2019 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6):

	Average Measurement	Average Mass Discharged
BOD <sub>5</sub>	7.8 $\text{mg/L}$ *	
TSS	5.0 $\text{mg/L}$	
pH field	6.6 s.u.	
Fecal Coliform	120#/100 mL	
Phosphorus	0.31 $\text{mg/L}$	0.70 $\text{lbs/day}$

\*Results below the level of detection (LOD) were included as zeroes in calculation of average.

## **PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR TOXIC SUBSTANCES – EXCEPT AMMONIA NITROGEN**

In general, permit limits for toxic substances are recommended whenever any of the following occur:

1. The maximum effluent concentration exceeds the calculated limit (s. NR 106.05(3), Wis. Adm. Code)
2. If 11 or more detected results are available in the effluent, the upper 99<sup>th</sup> percentile (or P<sub>99</sub>) value exceeds the comparable calculated limit (s. NR 106.05(4), Wis. Adm. Code)
3. If fewer than 11 detected results are available, the mean effluent concentration exceeds 1/5 of the calculated limit (s. NR 106.05(6), Wis. Adm. Code)

### **Acute Limits based on 1-Q<sub>10</sub>:**

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. Previously daily maximum limits for toxic substances were calculated as two times the ATC. However, changes to ch. NR 106, Wis. Adm. Code (September 1, 2016) require the Department to calculate acute limitations using the same mass balance equation as used for other limits along with the 1-Q<sub>10</sub> receiving water low flow to determine if more restrictive effluent limitations are needed to protect the receiving stream from discharges which may cause or contribute to an exceedance of the acute water quality standards.

$$\text{Limitation} = \frac{(\text{WQC}) (Q_s + (1-f) Q_e) - (Q_s - f Q_e) (C_s)}{Q_e}$$

Where:

WQC = Acute toxicity criterion or secondary acute value according to ch. NR 105

Q<sub>s</sub> = average minimum 1-day flow which occurs once in 10 years (1-day Q<sub>10</sub>)

if the 1-day Q<sub>10</sub> flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q<sub>10</sub>).

Q<sub>e</sub> = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d)

f = Fraction of the effluent flow that is withdrawn from the receiving water, and

C<sub>s</sub> = Background concentration of the substance (in units of mass per unit volume) as specified in s. NR 106.06(4)(e).

As a rule of thumb, if the receiving water is effluent dominated under low stream flow conditions, the 1-Q<sub>10</sub> method of limit calculation produces the most stringent daily maximum limitations and should be used while making reasonable potential determinations. This is not the case for Village of Osceola and the limits are set based on two times the acute toxicity criteria.

The following tables list the water quality-based effluent limitations for this discharge along with the results of effluent sampling for all the detected substances. All concentrations are expressed in terms of micrograms per Liter (µg/L), except for hardness and chloride (mg/L).

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**Daily Maximum Limits based on Acute Toxicity Criteria (ATC)**

RECEIVING WATER FLOW = 880 cfs, (1-Q<sub>10</sub> (estimated as 80% of 7-Q<sub>10</sub>)).

SUBSTANCE	REF. HARD. mg/L	ATC	MAX. EFFL. LIMIT*	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P <sub>99</sub>	1-day MAX. CONC.
Arsenic		340	680	135.9	<1.0		<1.0
Cadmium	216	25.0	49.9	10.0	<3		<3
Chromium	216	3392	678302	1357	<6		<6
Copper	216	32.1	64.3			27	24
Lead	216	225	450.6	90.1	<1		<1
Nickel	216	901	1802.2	360	11		11
Zinc	216	236	472.7	94.5	40		40
Chloride (mg/L)		757	1514	303	240		247

\* The 2 × ATC method of limit calculation yields a more restrictive limit than consideration of ambient concentrations and 1-Q<sub>10</sub> flow rates per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016.

**Weekly Average Limits based on Chronic Toxicity Criteria (CTC)**

RECEIVING WATER FLOW = 275 cfs (¼ of the 7-Q<sub>10</sub>)

SUBSTANCE	REF. HARD. mg/L	CTC	MEAN BACK- GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P <sub>99</sub>
Arsenic		152.2		44791	8958.1	<1.0	
Cadmium	106	2.57	0.0041	755.12	151.0	<3	
Chromium	106	138.38		40724	8144.7	<6	
Copper	106	10.86	0.618	3014.7			19
Lead	106	29.58	0.0975	8676.4	1735.3	<1	
Nickel	106	54.76		16115	3223.0	11	
Zinc	106	126.49	0.75	37005	7400.9	40	
Chloride (mg/L)		395	5.9	114513	22902.7	240	

**Monthly Average Limits based on Wildlife Criteria (WC)**

The effluent characterization did not include any effluent sampling results for substances for which Wildlife Criteria exist.

**Monthly Average Limits based on Human Threshold Criteria (HTC)**

RECEIVING WATER FLOW = 800 cfs (¼ of the Harmonic Mean)

SUBSTANCE	HTC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Cadmium	370		316051	63210	<3
Chromium (+3)	3818000		3.3x10 <sup>9</sup>	6.5x10 <sup>8</sup>	<6
Lead	140	0.0975	119505	23901	<1
Nickel	43000		3.7x10 <sup>7</sup>	7.3x10 <sup>6</sup>	11

**Monthly Average Limits based on Human Cancer Criteria (HCC)**

RECEIVING WATER FLOW = 800 cfs (¼ of the Harmonic Mean)

SUBSTANCE	HCC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Arsenic	13.3		11360.9	2272.18	<1.0

In addition to evaluating the need for limits for each individual substance for which HCC exist, s. NR 106.06(8) requires the evaluation of the cumulative cancer risk. Because effluent data is available for only one substance for which Human Cancer Criteria exists, and it was not detected in the effluent, determination of the cumulative cancer risk is not needed per s. NR 106.06(8), Wis. Adm. Code.

**Conclusions and Recommendations:**

Based on a comparison of the effluent data and calculated effluent limitations, no effluent limitations for toxic substances are recommended in the reissued permit.

Copper, Total Recoverable – Considering available effluent data from the current permit term (January 2018 – January 2019), the 1-day and 4-day P<sub>99</sub> concentrations are 27 and 19 µg/L respectively with a maximum concentration of 24 µg/L. The copper sample of 57 µg/L was determined to be an outlier using the Grubb's one-tailed test and was not used in the P<sub>99</sub> calculations. These effluent concentrations are below the calculated WQBELs for copper, therefore no effluent limits are needed. Copper monitoring is recommended in the third year of the reissued permit term to ensure that 11 sample results are available at the next permit issuance to meet the data requirements of s. NR 106.05(4).

Hardness, Total as CaCO<sub>3</sub> – Monthly monitoring is recommended during the third year of the reissued permit term because of the relationship between hardness and daily maximum limits based on acute toxicity criteria.

Chloride – Considering available effluent data from the current permit term (January 2018 – October 2018), the mean effluent concentration is 240 mg/L. These effluent concentrations are below the calculated WQBELs for chloride, therefore no effluent limits are needed. Chloride monitoring is recommended in the third year of the reissued permit term to ensure that 11 sample results are available at the next permit issuance to meet the data requirements of s. NR 106.85.

Mercury – The permit application did not require monitoring for mercury because the Village of Osceola is categorized as a minor facility as defined in s. NR 200.02(8), Wis. Adm. Code. In accordance with s. NR 106.145(3)(a)3., a minor municipal discharger shall monitor, and report results of influent and effluent mercury monitoring once every three months if, “there are two or more exceedances in the last five years of the high-quality sludge mercury concentration of 17 mg/kg specified in s. NR 204.07(5).” A review of the past five years of sludge characteristics data reveals that all the sample results are within expected analytical ranges and well below the 17 mg/kg level. The average concentration in the sludge from November 2015 – February 2018 was 1.2 mg/kg, with a maximum reported concentration of 2.1 mg/kg. Therefore, no mercury monitoring is recommended at Outfall 001.



### PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR AMMONIA NITROGEN

The State of Wisconsin promulgated revised water quality standards for this substance effective March 1, 2004 which includes criteria based on both acute and chronic toxicity to aquatic life. Given the fact that the Village of Osceola does not currently have ammonia nitrogen limits the need for limits is evaluated at this time.

#### Daily Maximum Limits based on Acute Toxicity Criteria (ATC):

Daily maximum limitations are based on acute toxicity criteria, which are a function of the effluent pH and the receiving water classification. The acute toxicity criterion (ATC) for ammonia is calculated using the following equation.

$$\text{ATC in mg/L} = [A \div (1 + 10^{(7.204 - \text{pH})})] + [B \div (1 + 10^{(\text{pH} - 7.204)})]$$

Where:

A = 0.411 and B = 58.4 for a Warm Water Sport fishery, and  
pH (s.u.) = that characteristic of the effluent.

The effluent pH data was examined as part of this evaluation. A total of 1,492 sample results were reported from October 2014 – April 2019. The maximum reported value was 7.5 s.u. (Standard pH Units). The effluent pH was 7.4 s.u. or less 99% of the time. The 1-day P<sub>99</sub>, calculated in accordance with s. NR 106.05(5), is 7.47 s.u. And the mean plus the standard deviation multiplied by a factor of 2.33, an estimate of the upper ninety ninth percentile for a normally distributed dataset, is 7.43 s.u. Therefore, a value of 7.4 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen. Substituting a value of 7.4 s.u. into the equation above yields an ATC = 23.0 mg/L and a computed daily maximum limit of 46 mg/L using two times the ATC.

#### Potential Changes to Daily Maximum Ammonia Nitrogen Effluent Limitations:

Updates to subchapter IV of ch. NR 106, Wis. Adm. Code (effective September 1, 2016) outline the option for the Department to implement use of the 1-Q<sub>10</sub> receiving water low flow to calculate daily maximum ammonia nitrogen limits if it is determined that the previous method of acute ammonia limit calculation (2×ATC) is not sufficiently protective of the fish and aquatic life. The more restrictive calculated limits would apply.

The calculated daily maximum ammonia nitrogen effluent limits using the mass balance approach with the 1-Q<sub>10</sub> (estimated as 80 % of 7-Q<sub>10</sub>) and the 2×ATC approach are shown below.

	Ammonia Nitrogen Limit mg/L
2×ATC	46
1-Q <sub>10</sub>	21545

The 2×ATC method yields the most stringent limits for the Village of Osceola.

Presented below is a table of daily maximum limitations corresponding to various effluent pH values.

**Daily Maximum Ammonia Nitrogen Limits – WWSF**

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
6.0 < pH ≤ 6.1	108	7.0 < pH ≤ 7.1	66	8.0 < pH ≤ 8.1	14
6.1 < pH ≤ 6.2	106	7.1 < pH ≤ 7.2	59	8.1 < pH ≤ 8.2	11
6.2 < pH ≤ 6.3	104	7.2 < pH ≤ 7.3	52	8.2 < pH ≤ 8.3	9.4
6.3 < pH ≤ 6.4	101	7.3 < pH ≤ 7.4	46	8.3 < pH ≤ 8.4	7.8
6.4 < pH ≤ 6.5	98	7.4 < pH ≤ 7.5	40	8.4 < pH ≤ 8.5	6.4
6.5 < pH ≤ 6.6	94	7.5 < pH ≤ 7.6	34	8.5 < pH ≤ 8.6	5.3
6.6 < pH ≤ 6.7	89	7.6 < pH ≤ 7.7	29	8.6 < pH ≤ 8.7	4.4
6.7 < pH ≤ 6.8	84	7.7 < pH ≤ 7.8	24	8.7 < pH ≤ 8.8	3.7
6.8 < pH ≤ 6.9	78	7.8 < pH ≤ 7.9	20	8.8 < pH ≤ 8.9	3.1
6.9 < pH ≤ 7.0	72	7.9 < pH ≤ 8.0	17	8.9 < pH ≤ 9.0	2.6

#### **Weekly Average & Monthly Average Limits based on Chronic Toxicity Criteria (CTC)**

The ammonia limit calculation also warrants evaluation of weekly and monthly average limits based on chronic toxicity criteria for ammonia, since those limits relate to the assimilative capacity of the receiving water.

Weekly average and monthly average limits for ammonia nitrogen are based on chronic toxicity criteria. The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified as a Warm Water Sport Fish Community is calculated by the following equation.

$$CTC = E \times \{ [0.0676 \div (1 + 10^{(7.688 - pH)})] + [2.912 \div (1 + 10^{(pH - 7.688)})] \} \times C$$

Where:

pH = the pH (s.u.) of the receiving water,

E = 0.854,

C = the minimum of 2.85 or  $1.45 \times 10^{(0.028 \times (25 - T))}$  – (Early Life Stages Present), or

C =  $1.45 \times 10^{(0.028 \times (25 - T))}$  – (Early Life Stages Absent), and

T = the temperature (°C) of the receiving water – (Early Life Stages Present), or

T = the maximum of the actual temperature (°C) and 7 – (Early Life Stages Absent)

The 4-day criterion is simply equal to the 30-day criterion multiplied by 2.5. The 4-day criteria are used in a mass-balance equation with the 7-Q<sub>10</sub> (4-Q<sub>3</sub>, if available) to derive weekly average limitations. And the 30-day criteria are used with the 30-Q<sub>5</sub> (estimated as 85% of the 7-Q<sub>2</sub> if the 30-Q<sub>5</sub> is not available) to derive monthly average limitations. The stream flow value is further adjusted to temperature; 100% of the flow is used if the Temperature ≥ 16 °C, 25% of the flow is used if the Temperature < 11 °C, and 50% of the flow is used if the Temperature ≥ 11 °C but < 16 °C.

The rules provide a mechanism for less stringent weekly average and monthly average effluent limitations when early life stages (ELS) of critical organisms are absent from the receiving water. This applies only when the water temperature is less than 14.5 °C, during the winter and spring months. Burbot, an early spawning species, are not believed to be present in the St. Croix River, based on conversations with local

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fisheries biologists. So “ELS Absent” criteria apply from November – April, and “ELS Present” criteria will apply from May – October for a Warm Water Sport Fish Community classification.

Since minimal ambient data is available, the “default” basin assumed values are used for Temperature, pH and background ammonia concentrations, shown in the table below, with the resulting criteria and effluent limitations.

		Summer May – Oct.	Winter Nov. – April
<b>Effluent Flow</b>	Qe (MGD)	0.606	0.606
<b>Background Information</b>	7-Q <sub>10</sub> (cfs)	1100	1100
	7-Q <sub>2</sub> (cfs)	1530	1530
	Ammonia (mg/L)	0.04	0.08
	Average Temperature (°C)	19	3
	Maximum Temperature (°C)	24	8
	pH (s.u.)	7.90	7.75
	% of Flow used	100	25
	Reference Weekly Flow (cfs)	1100	275
	Reference Monthly Flow (cfs)	1301	325
<b>Criteria mg/L</b>	4-day Chronic		
	Early Life Stages Present	3.82	-
	Early Life Stages Absent	-	13.0
	30-day Chronic		
	Early Life Stages Present	1.53	-
	Early Life Stages Absent	-	5.22
<b>Effluent Limitations mg/L</b>	Weekly Average		
	Early Life Stages Present	4441	-
	Early Life Stages Absent	-	3816
	Monthly Average		
	Early Life Stages Present	2067	-
	Early Life Stages Absent	-	1787

Section NR 106.33(2) was also updated effective September 1, 2016. As a result, seasonal 20 and 40 mg/L thresholds for including ammonia limits in municipal discharge permits are no longer applicable under current rules. As such, s. NR 106.33(1) enables the Department to determine the need to include ammonia limits in municipal discharge permits based on the statistical comparisons in s. NR 106.05.

**Effluent Data:**

The following table evaluates the statistics based upon ammonia data reported from November 2012 – April 2018, with those results being compared to the calculated limits to determine the need to include ammonia limits in the Village of Osceola permit for the respective month ranges. That need is determined by calculating 99<sup>th</sup> upper percentile (or P<sub>99</sub>) values for ammonia during each of the month ranges and comparing the daily maximum values to the daily maximum limit. Based on this comparison, daily maximum limits are required in the months of November – April. It should be noted available ammonia data was not available from May – October.

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Ammonia Nitrogen mg/L	November – April
1-day P <sub>99</sub>	59
4-day P <sub>99</sub>	33
30-day P <sub>99</sub>	20
Mean*	14
Std	12
Sample size	18
Range	0.1 – 35

\*Values lower than the level of detection were substituted with a zero

**Conclusions and Recommendations:**

In summary, a daily maximum ammonia nitrogen limitation of 46 mg/L is recommended. The daily maximum variable limit table may be used in place of the single limit. No mass limitations are recommended in accordance with s. NR 106.32(5).

Monitoring is recommended for the months of May – October during the third year of the reissued permit term to ensure that 11 sample results are available at the next permit issuance to meet the data requirements of s. NR 106.05(4).

Additional limits to meet the expression of limits requirements in s. NR 106.07 are addressed in Part 7 of this memorandum.

**PART 4 –PHOSPHORUS**

**Technology Based Phosphorus Limit**

Wisconsin Administrative Code, ch. NR 217, requires municipal wastewater treatment facilities that discharge greater than 150 pounds of Total Phosphorus per month to comply with a monthly average limit of 1.0 mg/L, or an approved alternative concentration limit.

Because the Village of Osceola currently has a limit of 1.0 mg/L, this limit should be included in the reissued permit. This limit remains applicable unless a more stringent water quality-based concentration limit is given. In addition, the need for a WQBEL for phosphorus must be considered.

**Water Quality-Based Effluent Limits (WQBEL)**

Revisions to administrative rules regulating phosphorus took effect on December 1, 2010. These rule revisions include additions to ch. NR 102 (s. NR 102.06), which establish phosphorus standards for surface waters. Revisions to ch. NR 217 (s. NR 217, Subchapter III) establish procedures for determining WQBELs for phosphorus, based on the applicable standards in ch. NR 102.

Section NR 102.06(3)(a) specifically names river segments for which a phosphorus criterion of 0.100 mg/L applies. For other stream segments that are not specified in s. NR 102.06(3)(a), s. NR 102.06(3)(b), Wis. Adm. Code, specifies a phosphorus criterion of 0.075 mg/L. The phosphorus criterion of 0.100 mg/L applies for St. Croix River.

#### Attachment #1

The conservation of mass equation is described in s. NR 217.13 (2)(a), Wis. Adm. Code, for phosphorus WQBELs and includes variables of water quality criterion (WQC), receiving water flow rate (Qs), effluent flow rate (Qe), and upstream phosphorus concentrations (Cs):

$$\text{Limitation} = [(WQC)(Q_s + (1-f) Q_e) - (Q_s - f Q_e) (C_s)] / Q_e$$

Where:

WQC = 0.100 mg/L for St. Croix River.

Qs = 100% of the 7-Q<sub>2</sub> of 1,530 cfs

Cs = background concentration of phosphorus in the receiving water pursuant to s. NR 217.13(2)(d), Wis. Adm. Code

Qe = effluent flow rate = 0.606 MGD = 0.938 cfs

f = the fraction of effluent withdrawn from the receiving water = 0

Section NR 217.13(2)(d), Wis. Adm. Code, specifies that the background phosphorus concentration used in the limit calculation formula shall equal the median of at least four samples collected during the months of May through October, and that all samples collected during a 28-day period shall be considered as a single sample and the average of these concentrations used to determine a median. Averaging begins at date of the first sample in the range of May through October.

A previous evaluation resulted in a WQBEL of 100 mg/L using a background concentration of 0.038 mg/L. Section NR 217.13(2)(d) states that the determination of upstream concentrations shall be evaluated at each permit reissuance. Additional data were considered in estimating the background phosphorus concentration.

A review of all available in stream total phosphorus data from May 2007 – June 2017 stored in the Surface Water Integrated Monitoring System database indicates the median background total phosphorus concentration in St. Croix River at the Interstate Park boat landing (SWIMS station ID 493210) is 0.048 mg/L, approximately 8.0 miles upstream from the point of discharge to St. Croix River.

Substituting a median value of 0.048 mg/L into the limit calculation equation above, the calculated limit is 85 mg/L.

#### Effluent Data

The following table summarizes effluent total phosphorus monitoring data from October 2014 – April 2019.

	Phosphorus mg/L	Phosphorus lbs/day
1-day P <sub>99</sub>	0.86	2.0
4-day P <sub>99</sub>	0.55	1.3
30-day P <sub>99</sub>	0.39	0.88
Mean	0.31	0.70
Std	0.16	0.38
Sample size	713	698
Range	0.1 – 2.19	0.21 – 5.06

### **Reasonable Potential Determination**

Since the 30-day  $P_{99}$  of reported effluent total phosphorus data is less than the calculated WQBEL, the discharge does not have reasonable potential to cause or contribute to an exceedance of the water quality criterion. It should be noted that both the TBEL and TMDL-based WQBEL in the current permit are more stringent than the calculated WQBEL using s. NR 217.13, and are protective of the receiving water in this case.

### **TMDL Limits**

The Lake St. Croix TMDL established a waste load allocation (WLA) for the Village of Osceola of 2,284 lbs/yr and 6.3 lbs/day. The monthly average limit of 9.2 lbs/day was determined in the previous WQBEL memorandum (March 2014). The multiplier of 1.47 was chosen utilizing the parameters of  $CV = 0.6$  and a 3 samples per week effluent monitoring as described in *TMDL Development and Implementation Guidance: Integrating the WPDES and Impaired Waters Programs Edition No. 3*.

This TMDL-based WQBEL will be reevaluated if the annual WLA is not being met as described in the prior stated guidance. This is done by comparing the sum of the most recent 12 consecutive months of total monthly mass discharges directly against the annual WLA. In this case, the most recent sum of 305 lbs/yr (May 2018 – April 2019) is less than the annual WLA of 2,284 lbs/yr. Therefore, the Village of Osceola is meeting their annual WLA and the TMDL-based WQBEL of 9.2 lbs/day as a monthly average will be continued in the reissued permit.

## **PART 5 – THERMAL**

New surface water quality standards for temperature took effect on October 1, 2010. These new regulations are detailed in chs. NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

Due to the amount of upstream flow available for dilution in the limit calculation ( $Q_s:Q_e > 20:1$ ), the lowest calculated limitation is 120° F (s. NR 106.55(6)(a)). At temperatures above approximately 103° F, conventional biological treatment systems do not function properly and experience upsets. There is no indication that this has ever occurred in this treatment system. Therefore, there is no reasonable potential for the discharge to exceed this limit. No effluent limits or monitoring for temperature are required in the reissued permit.

## **PART 6 – WHOLE EFFLUENT TOXICITY (WET)**

WET testing is used to measure, predict, and control the discharge of toxic materials that may be harmful to aquatic life. In WET tests, organisms are exposed to a series of effluent concentrations for a given time and effects are recorded. The following evaluation is based on procedures in the Department's WET Program Guidance Document (revision #11, dated November 1, 2016).

- Chronic testing is usually not recommended where the ratio of the 7-Q<sub>10</sub> to the effluent flow exceeds

Attachment #1

100:1 and acute testing is not typically recommended if the ratio exceeds 1,000:1. For the Village of Osceola, that ratio is approximately 1,171:1. With this amount of dilution, there is believed to be little potential for acute or chronic toxicity effects in the St. Croix River associated with the discharge from the Village of Osceola, so the need for acute and chronic WET testing will not be considered further.

- Following the guidance provided in the Department's WET Program Guidance Document (revision #11, dated November 1, 2016), no WET testing is required.

## **PART 7 – EXPRESSION OF LIMITS**

Revisions to chs. NR 106 and 205, Wis. Adm. Code align Wisconsin's water quality-based effluent limits with 40 CFR 122.45(d), which requires WPDES permits contain the following concentration limits, whenever practicable and necessary to protect water quality:

- Weekly average and monthly average limitations for continuous discharges subject to ch. NR 210.
- Daily maximum and monthly average limitations for all other discharges.

The Village of Osceola is a municipal treatment facility and is therefore subject to weekly average and monthly average limitations whenever limitations are determined to be necessary.

This evaluation provides additional limitations necessary to comply with the expression of limits in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Code. Pollutants already compliant with these rules or that have an approved impracticability demonstration, are excluded from this evaluation including water-quality based effluent limitations for phosphorus, temperature, and pH, among other parameters. Mass limitations are not subject to the limit expression requirements if concentrations limits are given.

### **Method for Calculation:**

The methods for calculating limitations for continuous discharges subject to ch. NR 210 to conform to 40 CFR 122.45(d) are specified in s. NR 106.07(3), and are as follows:

1. Whenever a daily maximum limitation is determined necessary to protect water quality, a weekly and monthly average limitation shall also be included in the permit and set equal to the daily maximum limit unless a more restrictive limit is already determined necessary to protect water quality.
  - Ammonia Nitrogen: The reissued permit will implement pH variable daily maximum limits and the highest daily maximum limit allowed dependent on pH is more restrictive than the calculated weekly and monthly average limits. Therefore, weekly and monthly average limits of 108 mg/L are required seasonally during the months of November – April.
2. Whenever a weekly average limitation is determined necessary to protect water quality, a monthly average limitation shall also be included in the permit and set equal to the weekly average limit unless a more restrictive limit is already determined necessary to protect water quality.
3. Whenever a monthly average limitation is determined necessary to protect water quality, a weekly average limit shall be calculated using the following procedure and included in the permit unless a more restrictive limit is already determined necessary to protect water quality:

# Attachment #1

$$\text{Weekly Average Limitation} = (\text{Monthly Average Limitation} \times \text{MF})$$

Where:

MF= Multiplication factor as defined in Table 1

CV= coefficient of variation (CV) as calculated in s. NR 106.07(5m)

n= the number of samples per month required in the permit

s. NR 106.07 (3) (e) 4. Table 1 — Multiplication Factor (for CV = 0.6)

CV	n=1	n=2	n=3	n=4	n=8	n=12	n=16	n=20	n=24	n=30
0.6	1.00	1.31	1.51	1.64	1.95	2.12	2.23	2.30	2.36	2.43

Note: This methodology is based on the *Technical Support Document for Water Quality-based Toxics Control* (March 1991). PB91-127415.

- o Fecal Coliform: For this WWTF fecal coliform is sampled weekly and the CV is equal to 0.6, therefore, the MF used is 1.64. Multiplying the monthly average limit of 400#/100 mL by 1.64 yields a weekly geometric mean of 656 #/100 mL.

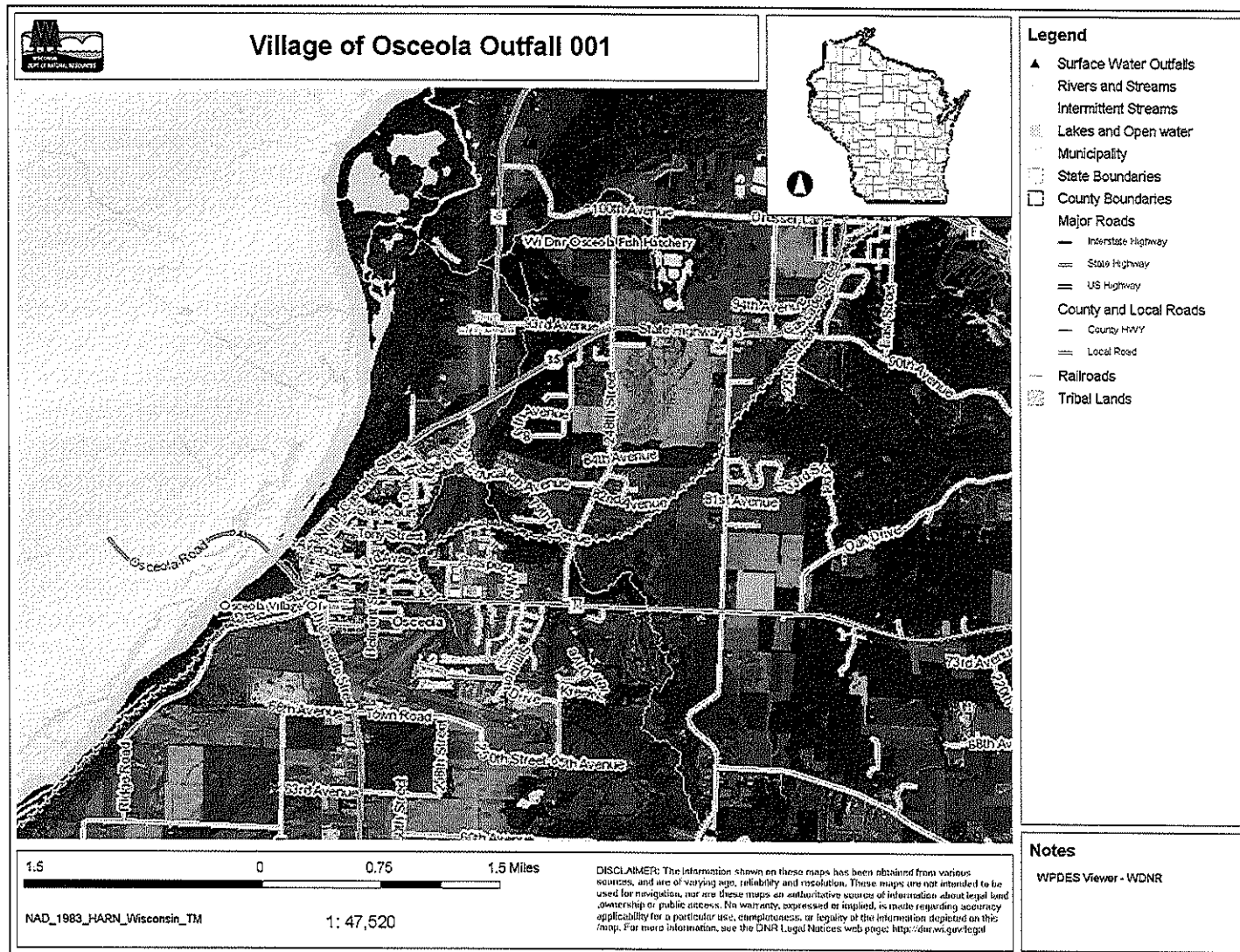
## Summary of Additional Limitations:

In conclusion, the following additional limitations are required to comply with ss. NR 106.07 and NR 205.065(7) Expression of Limits.

Parameter	Daily Maximum	Weekly Average	Monthly Average	Weekly Geometric Mean	Monthly Geometric Mean	Multiplication Factor (CV)	Assumed Monitoring Frequency (n)
Fecal Coliform				656#/100 mL	400#/100 mL	1.64 (0.6)	Weekly (4)
Ammonia Nitrogen November – April Variable table Or, if single limit	Variable 46 mg/L	108 mg/L 46 mg/L	108 mg/L 46 mg/L				



Attachment #2



## Attachment #3

Data	Source	Start Date	End Date	Sample Count	Notes
<b>Receiving Water - St. Croix River</b>					
WBIC	Surface Water Data Viewer	-	-	-	2601400
Classification	Permit Fact Sheet	-	-	-	Fish and Aquatic Life - Warm Water Sport Fish Community
Flow (Qs)	USGS Data - Station SW ¼, NW ¼, Sec. 30, T34N-R18W	-	-	3	
Ammonia	Ambient Ammonia Guidance	-	-	2	Guidance is based by drainage basin - St. Croix
Chloride	Ambient Metals Summary	-	-	1	St. Croix River @ Highway 8 near St. Croix Falls
Hardness	Historic WET tests	Sept. 1996	Mar. 2010	5	Geometric average
Phosphorus	Surface Water Integrated Monitoring System	May. 2007	Jun. 2017	18	ID-493210, 8 miles upstream of Outfall 001
Cadmium	Ambient Metals Summary	-	-	1	St. Croix River @ Highway 8 near St. Croix Falls
Chromium	No data available	-	-	1	Assumed to be zero
Copper	Ambient Metals Summary	-	-	1	St. Croix River @ Highway 8 near St. Croix Falls
Lead	Ambient Metals Summary	-	-	1	St. Croix River @ Highway 8 near St. Croix Falls
Nickel	No data available	-	-	1	Assumed to be zero
Mercury	Ambient Metals Summary	-	-	1	St. Croix River @ Highway 8 near St. Croix Falls
Zinc	Ambient Metals Summary	-	-	1	St. Croix River @ Highway 8 near St. Croix Falls
Temperature	Ambient Temperature Guidance	-	-	2	Guidance is based by classification - Large WWSF
pH	Ambient pH Guidance	-	-	2	Guidance is based on hardness
Multiple Dischargers	Surface Water Data Viewer	-	-	-	None in vicinity
Alternative % Low Flow	NR 106.06(4)(c)5	-	-	-	25% Default
Watershed/Basin	SWAMP	-	-	-	Trout Brook/Lower St. Croix River
Impaired Water Status	Surface Water Data Viewer	-	-	-	PCBs in fish tissue
Fish Species Determination	Infotrek - Bureau of Fisheries Management	-	-	-	Burbot is not present
<b>Effluent - Village of Osceola</b>					
Annual Average Design Flow	Permit Application and SWAMP	-	-	1	0.606 MGD

## Attachment #3

Design BOD Load	Facility Diagram and SWAMP	-	-	1	1,294 lbs/day
Actual Flow (Qe)	Discharge Monitoring Reports	Oct. 2014	Apr. 2019	1,673	Continuous discharger
Actual BOD	Discharge Monitoring Reports	Oct. 2014	Apr. 2019	713	
TSS	Discharge Monitoring Reports	Oct. 2014	Apr. 2019	713	
Ammonia	Discharge Monitoring Reports	Nov. 2012	Apr. 2018	18	
Chloride	Permit Application	Jan. 2018	Oct. 2018	4	
Hardness	Discharge Monitoring Reports	Jan. 2018	Oct. 2018	4	Geometric average
Phosphorus	Discharge Monitoring Reports	Oct. 2014	Apr. 2019	713/698/53	mg/L, lbs/day, lbs/year respectively
Phosphorus WLA	TMDL Implementation Guidance	-	-	2	Lake St. Croix TMDL, annual and daily mass loading
Cadmium	Permit Application	-	-	1	
Chromium	Permit Application	-	-	1	
Copper	Discharge Monitoring Reports	-	-	13	High sample deemed a outlier
Lead	Permit Application	-	-	1	
Nickel	Permit Application	-	-	1	
Mercury	Discharge Monitoring Reports	-	-	4	Mass values in biosolids - concentration not monitored
Zinc	Permit Application	-	-	1	
Max Temperature	No data available	-	-	0	Temperature not monitored in DMR
pH	Discharge Monitoring Reports	Oct. 2014	Apr. 2019	1,492	
Additives	Permit Application	-	-	1	Ferric Chloride in WWTF, polyphosphate in water source
Acute Dilution Factor (ZID)	SWAMP	-	-	-	Not used - Rare
Effluent Fraction					
Withdraw	Permit Application	-	-	-	All effluent is discharged
Water Source (Wastewater)	Permit Application	-	-	3	Osceola, Dresser, Ellsworth Biosolids Facility
Water Source (Potable)	Permit Application	-	-	2	Osceola Waterworks, Dresser
Ammonia Max Effluent pH	Ammonia Guidance	-	-	1	Upper 99th percentile used

